

Seasonal Prediction of Meteorological Drought Using Statistical-Dynamical Approaches

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➤ **Baseline probabilities of meteorological drought indicators**

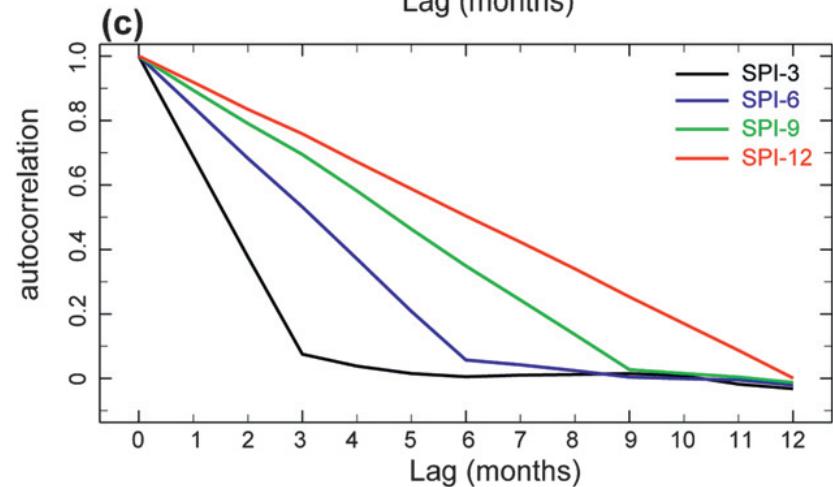
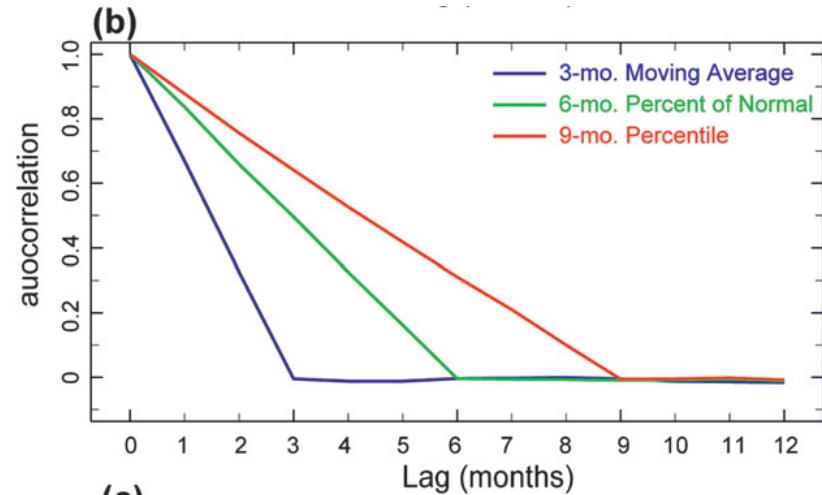
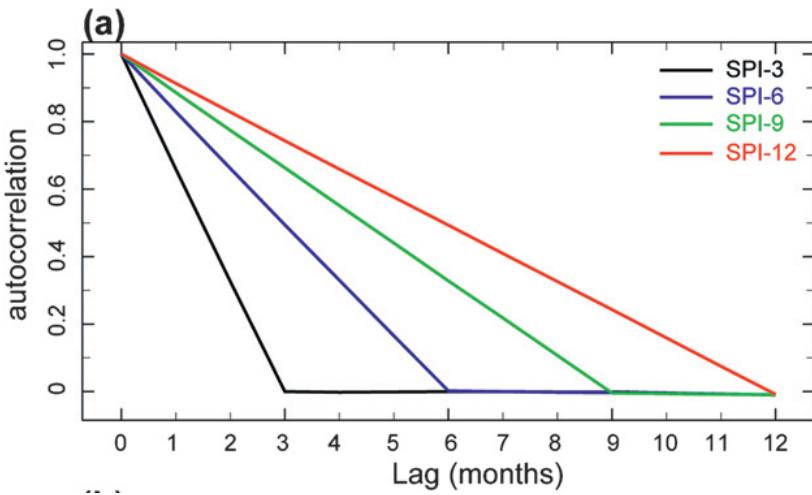
- Quantifying inherent persistence characteristics
- Optimal (baseline) persistence (vis-à-vis climatology → “ESP”)
- Some non-intuitive results

➤ **Dynamical model (CFSv2) predictions of the SPI**

- SST forcing only (AMIP, GFS)
- SST + Initialized land surface + Initialized Atm.
- Improvements over the baseline...

➤ **Enhancing NMME forecast skill through the use of MOS**

No Seasonality in Precipitation



Variance of monthly precipitation = σ^2

Variance, n-month average = σ^2/n

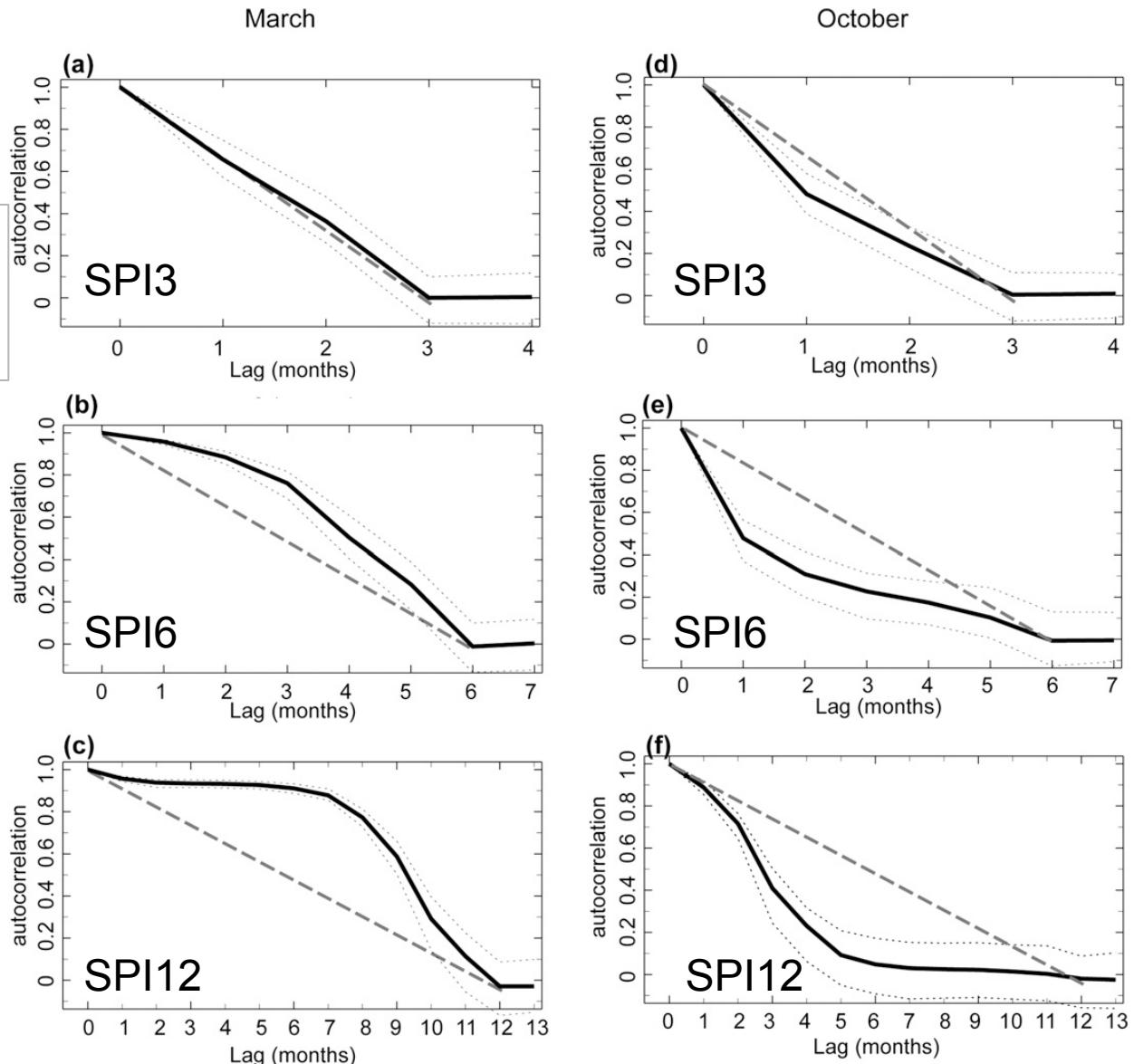
Covariance between adjacent values
in a moving average = $\sigma^2 (n - 1)/n^2$

1-month lag autocorrelation = $(n - 1)/n$

With Seasonality in Precipitation

→ Consider the State of California with strong annual cycle in precipitation

Seasonality giveth,
and taketh away, from
the AC...

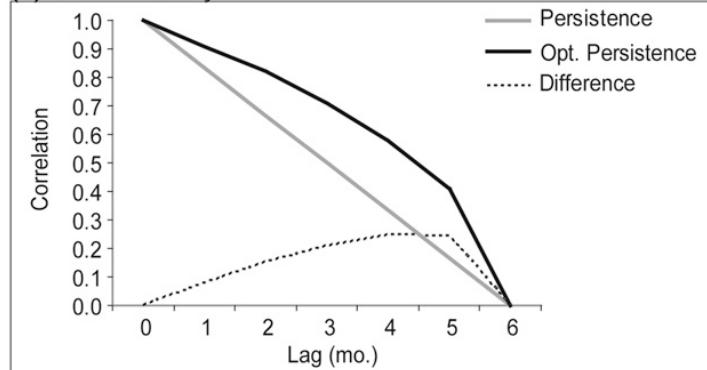


“Optimal” Persistence (for baseline case)

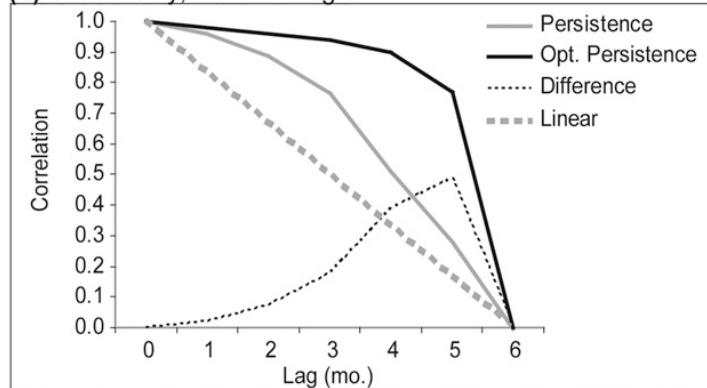
Two somewhat counterintuitive implications:

1. Although correlation “skill” decreases with increasing lag, the *improvement* over conventional persistence can in some cases *increase with increasing lag*.
2. The baseline forecasts are not constrained to decay with increasing lead time. *Recent conditions can actually lead to amplification!*

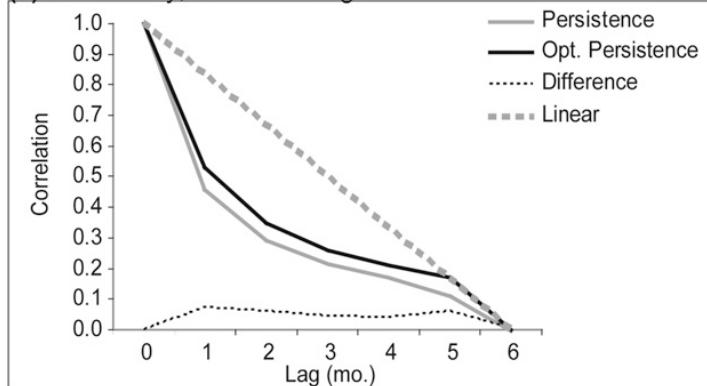
(a) No seasonality



(b) Seasonality, March = Lag 0



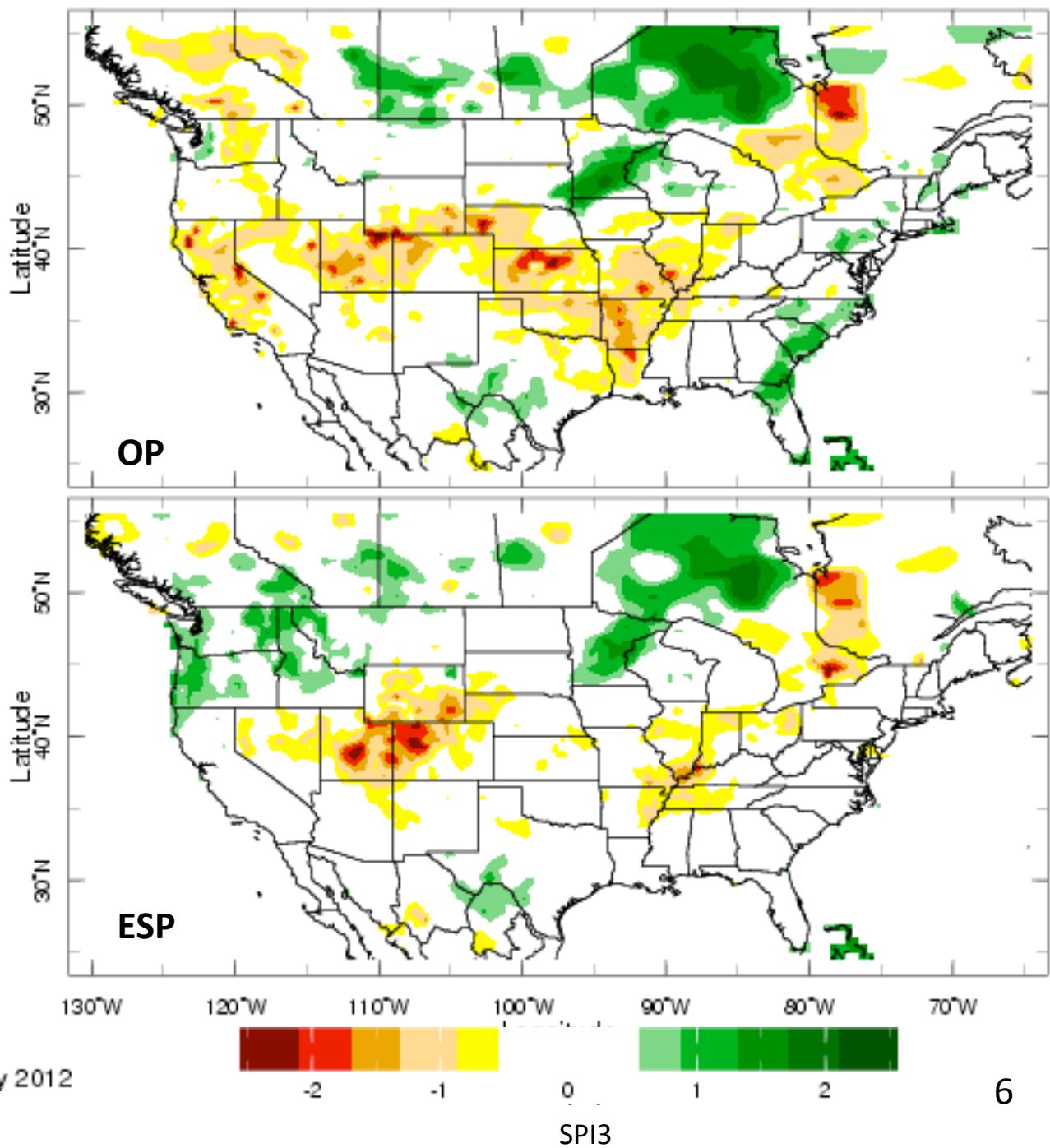
(c) Seasonality, October = Lag 0



Pers. Forecast SPI3

Issued: May 2012

Valid: July 2012

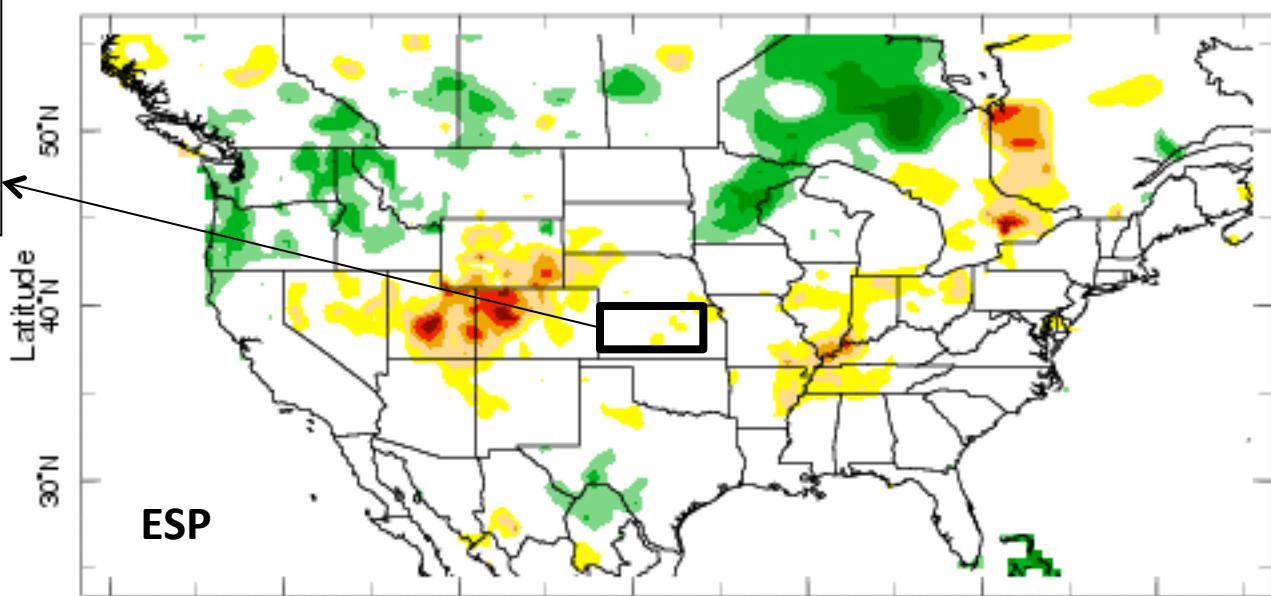
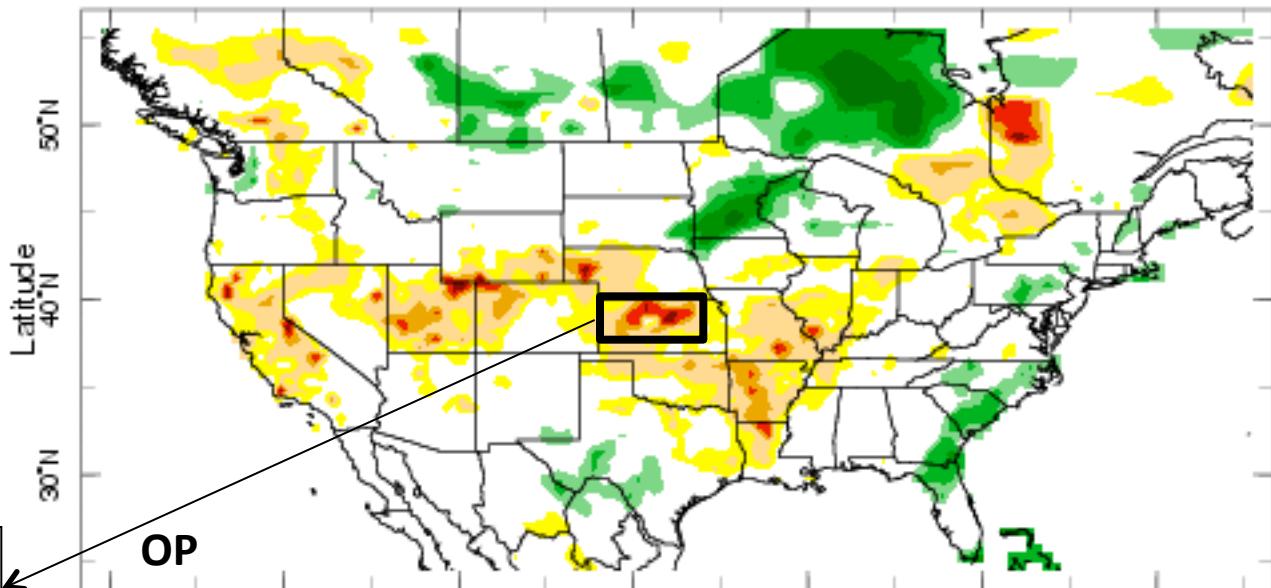


Pers. Forecast SPI3

Issued: May 2012

Valid: July 2012

Probability	
< -1.5	< -2.0
Climo:	6.6%
ESP:	3.3%
OP:	45.2%
	25.3%



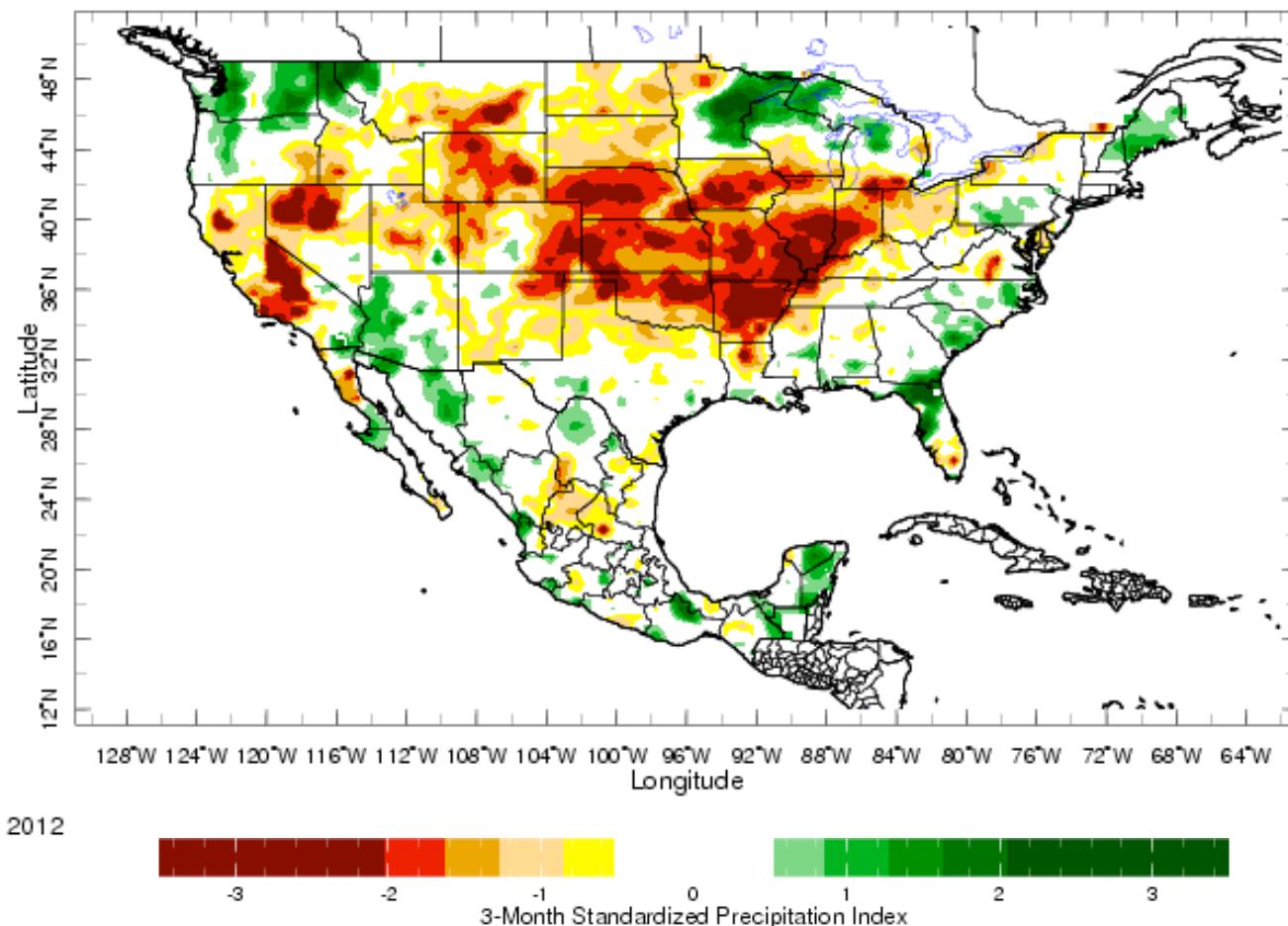
May 2012

130°W 120°W 110°W 100°W 90°W 80°W 70°W

-2 -1 0 1 2

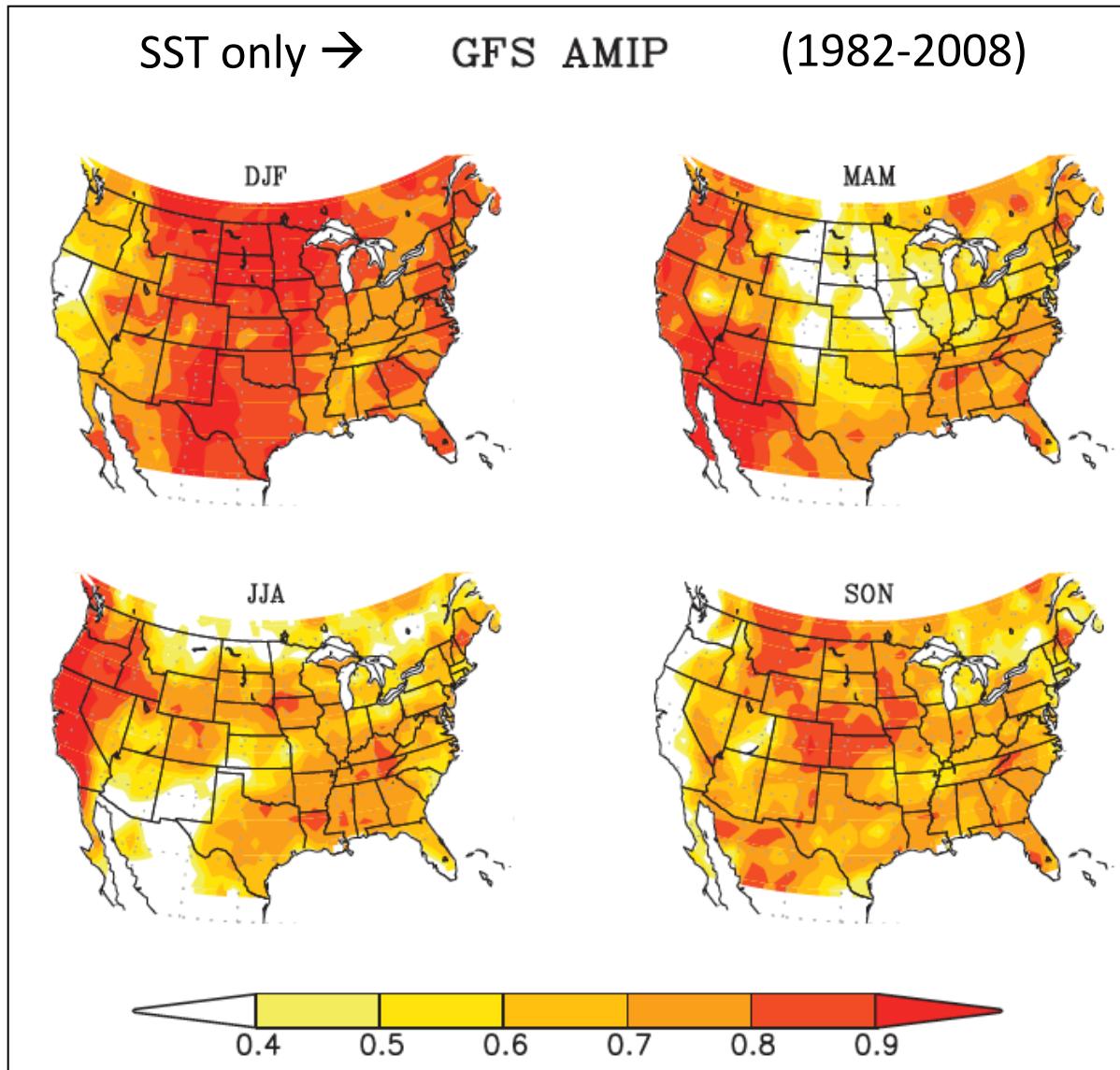
SPI3

Observed SPI3 July 2012

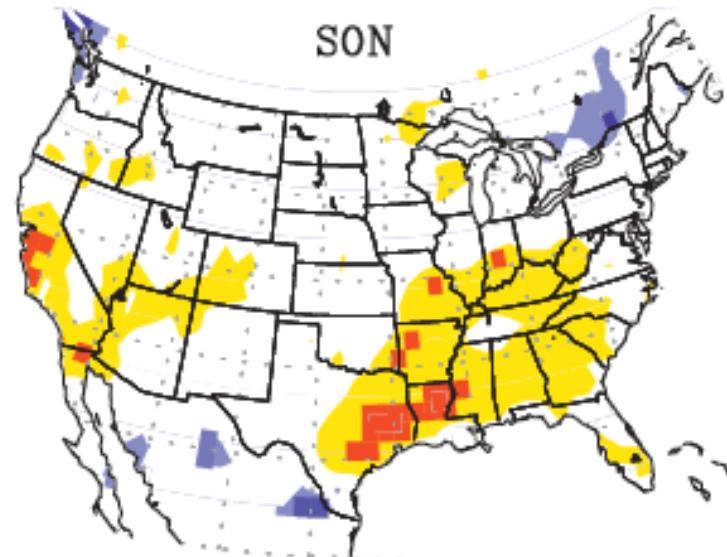
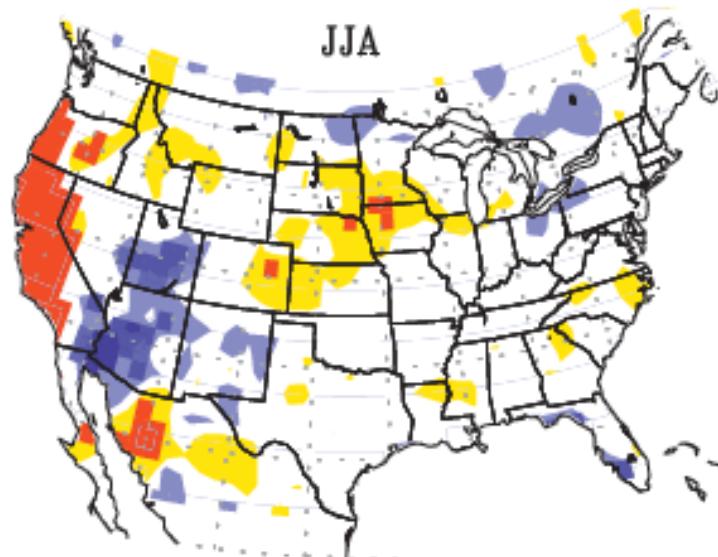
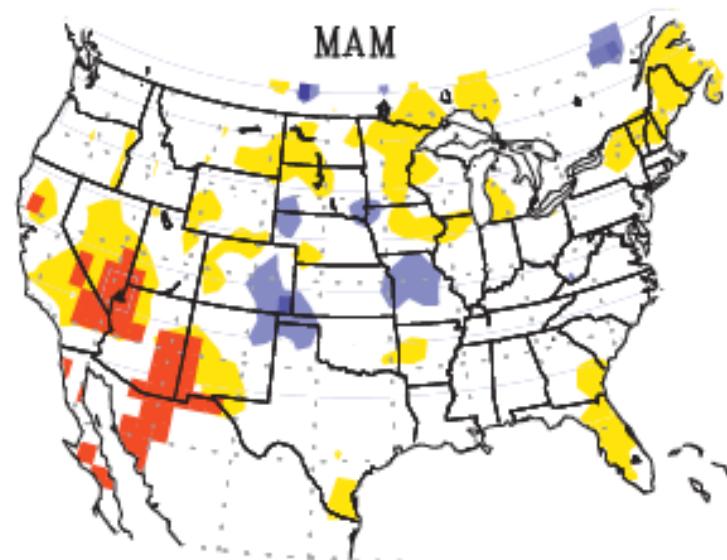
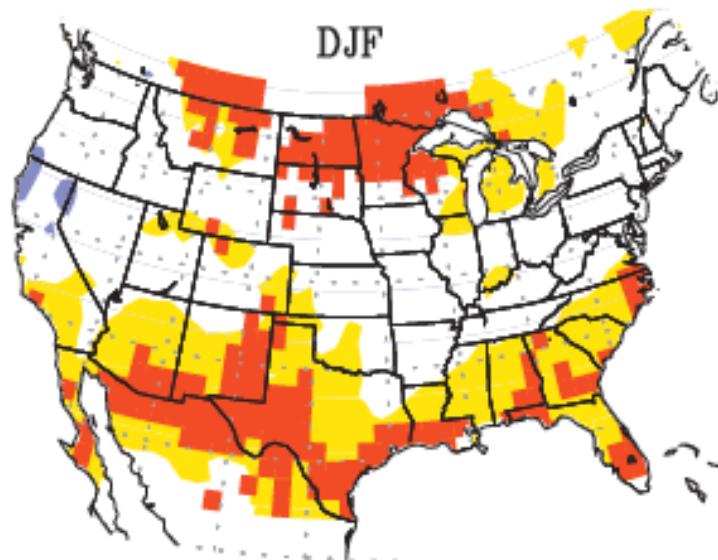


Sources of skill in the CFSv2 (that is beyond the baseline)

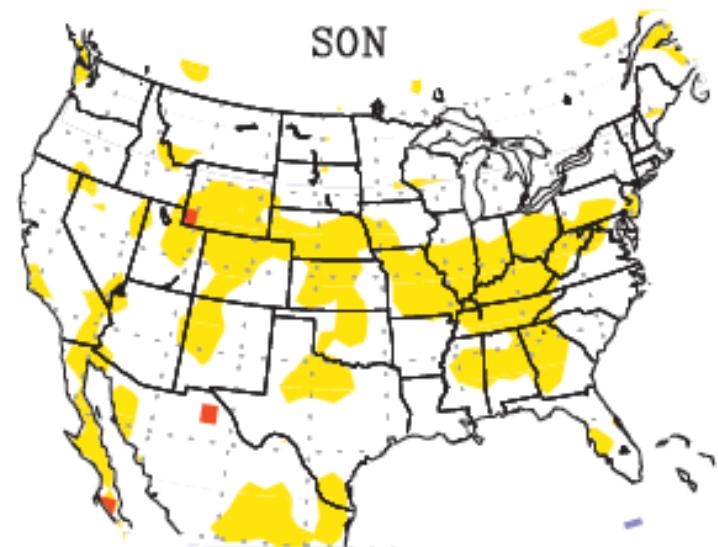
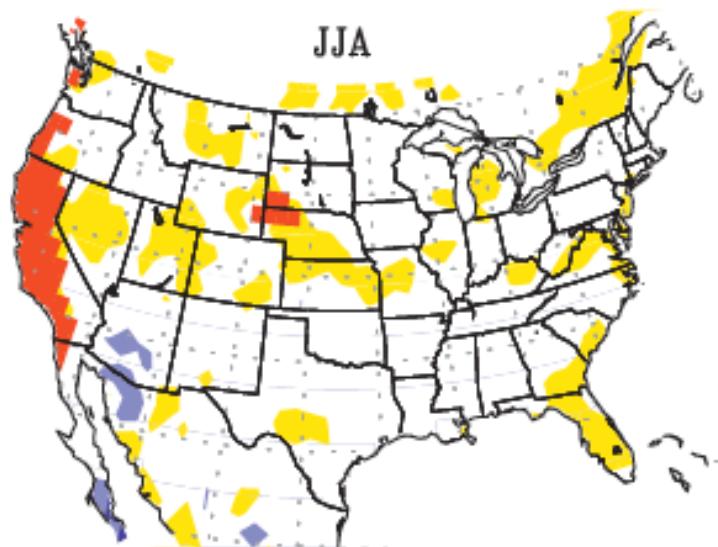
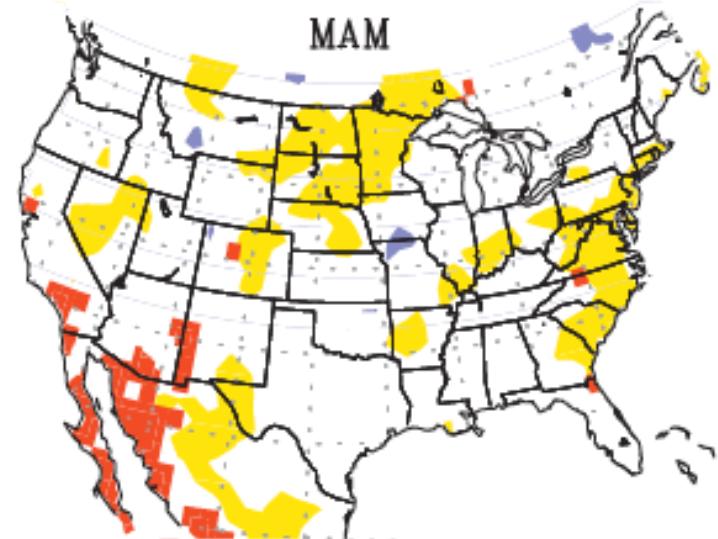
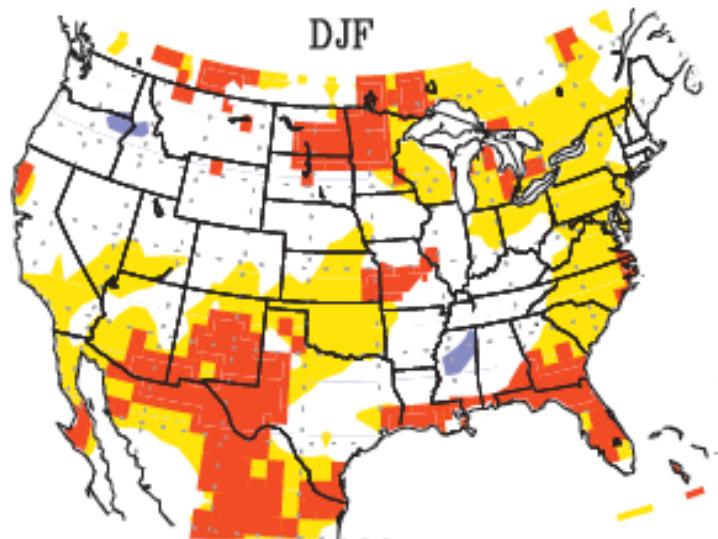
→ Example: Predicting the SPI6 1 season ahead



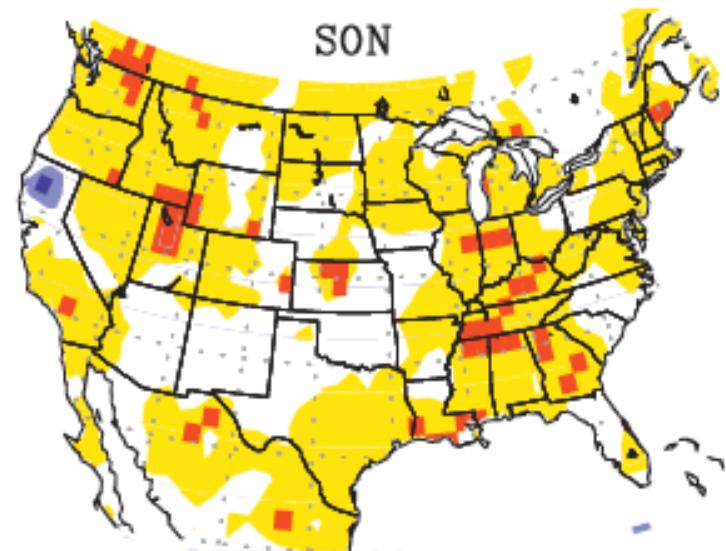
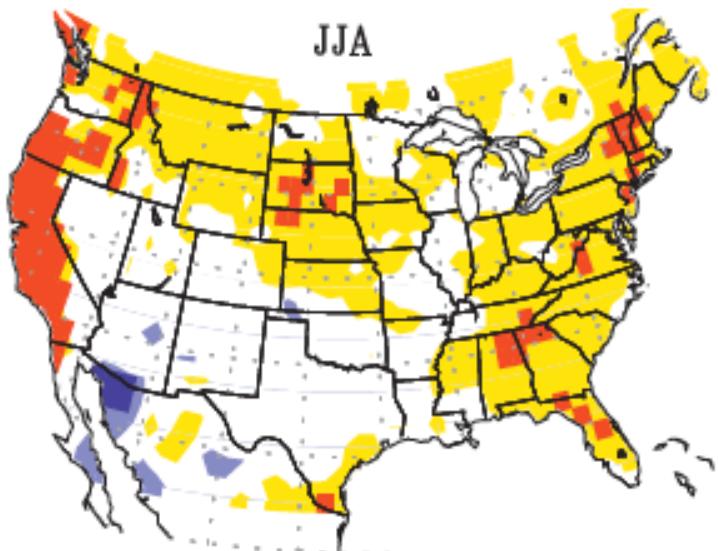
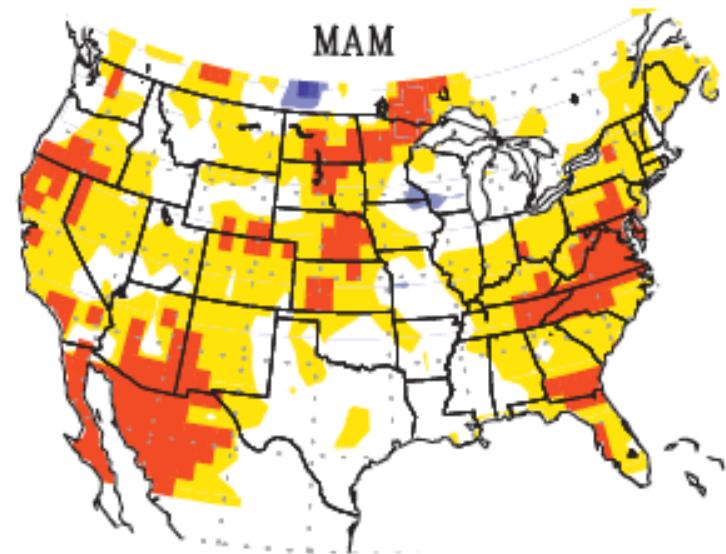
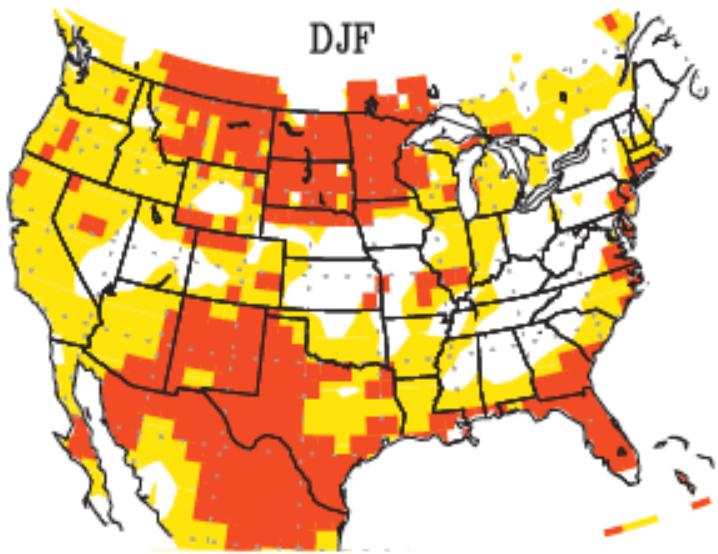
GFS AMIP – Baseline



CFS – Baseline



CFS(1mon) – Baseline

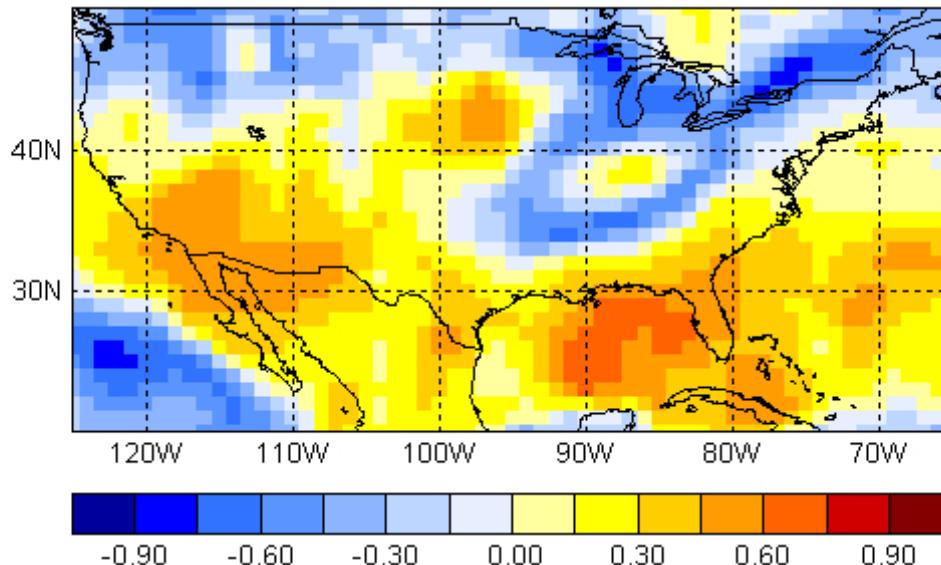


JFM precip correction of CFSv2 using 1 CCA mode
Average ACC = 0.04 5-yr cross-validation

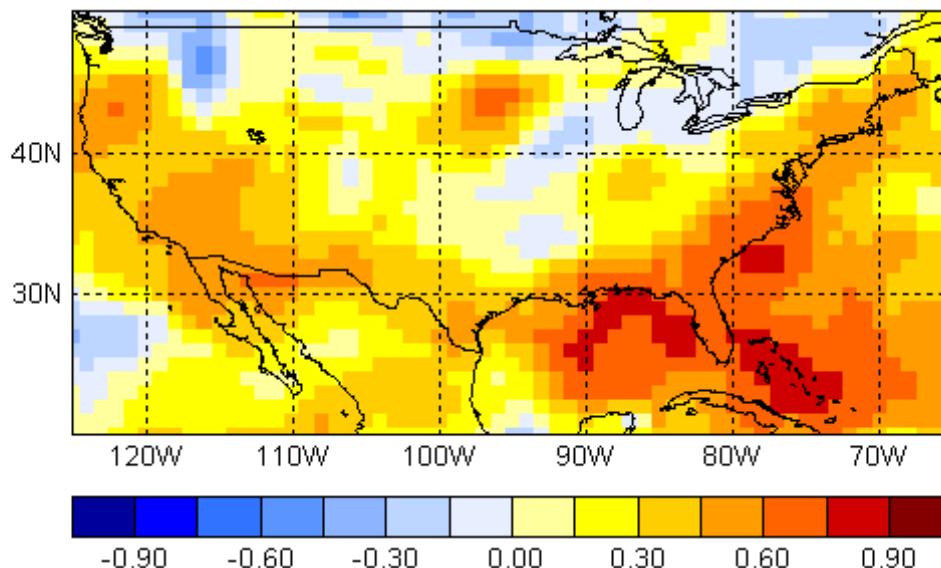
MOS Applied to the NMME forecasts

Addressing systematic *spatial
biases* in the models

Strict cross-validation



JFM precip correction of CFSv2 using 3 CCA modes
Average ACC = 0.19 5-yr cross-validation



References:

- Lyon, B., M.A. Bell, M.K. Tippett, A. Kumar, M.P. Hoerling, X.W. Quan and H. Wang, 2012: Baseline Probabilities for the Seasonal Prediction of Meteorological Drought. *Journal of Applied Meteorology and Climatology*, 51, 1222-1237.
- Quan, X., M.P Hoerling, B. Lyon, A. Kumar, M.A. Bell, M.K. Tippett, and H. Wang, 2012: Prospects for Dynamical Prediction of Meteorological Drought. *Journal of Applied Meteorology and Climatology*, 51, 1238-1252.